Space Weather Technical Forecast

Issued on Thursday, 28 March 2024 at 01:33 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further Minor/Moderate radio blackouts (R1/R2) expected. Electron Fluence likely rising above the Active threshold later in the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity recorded at GOES16 and 18 was Moderate with AR3615 producing a few M-class flares in past 24 hours, with the largest peaking at M1.1, observed at 27/0641 UTC. There are currently five active regions on the visible disc, with AR3615 the largest and most magnetically complex group (Fkc/Beta-Gamma-Delta), which continues to show further waxing/waning of the intermediate and trailer spots. All other remaining sunspot regions are comparatively small and simple with little change.
No significant Earth-directed Coronal Mass Ejections (CMEs) were observed in available coronagraph imagery over the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind at L1 measured by ACE and DSCOVR started at elevated levels (around 550km/s) in the aftermath of the CME that arrived on the 24th March, with a steady decline to slightly elevated levels by 27/1800 UTC. The solar wind density has been at average levels, but there appear to have been some significant data dropouts over the past 24 hours. The IMF was at weak levels, below 6nT. Bz fluctuated weakly between +4nT to -4nT. The phi angle has been generally positive (away from the sun).
The net result of the above solar wind measures was Unsettled to Quiet (Kp1-3) geomagnetic conditions.

Energetic Particles / Solar Radiation: Solar radiation was below the S1 threshold, but still a little above background levels with a declining trend evident. High energy electron flux (greater than 2MeV) observed at GOES16 was at Normal Background levels. The observed 24-hour fluence was below the Active threshold, with a value at 28/0000UTC of 3.58e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected to continue, with further isolated M-class flares expected primarily from the AR3615 through the forecast period, with a slight chance of an isolated X-class flare.

Solar Wind / Geomagnetic Activity: A CME associated with the X1.1 flare from a broad region north of AR3614 on the 23rd March, produced a complex halo CME which arrived at L1 at 24/1410UTC. There are no other Earth-directed CMEs currently in the forecast.
Solar winds at slightly elevated levels declining as the impacts from the CME continue to wane, along with any residual enhancement associated with CH12/- also clearing. Solar winds heading towards background values during days 1 and 2 (28-29 Mar) in the absence of any further enhancements.
Geomagnetic activity is expected to be Quiet to Unsettled for much of the period.

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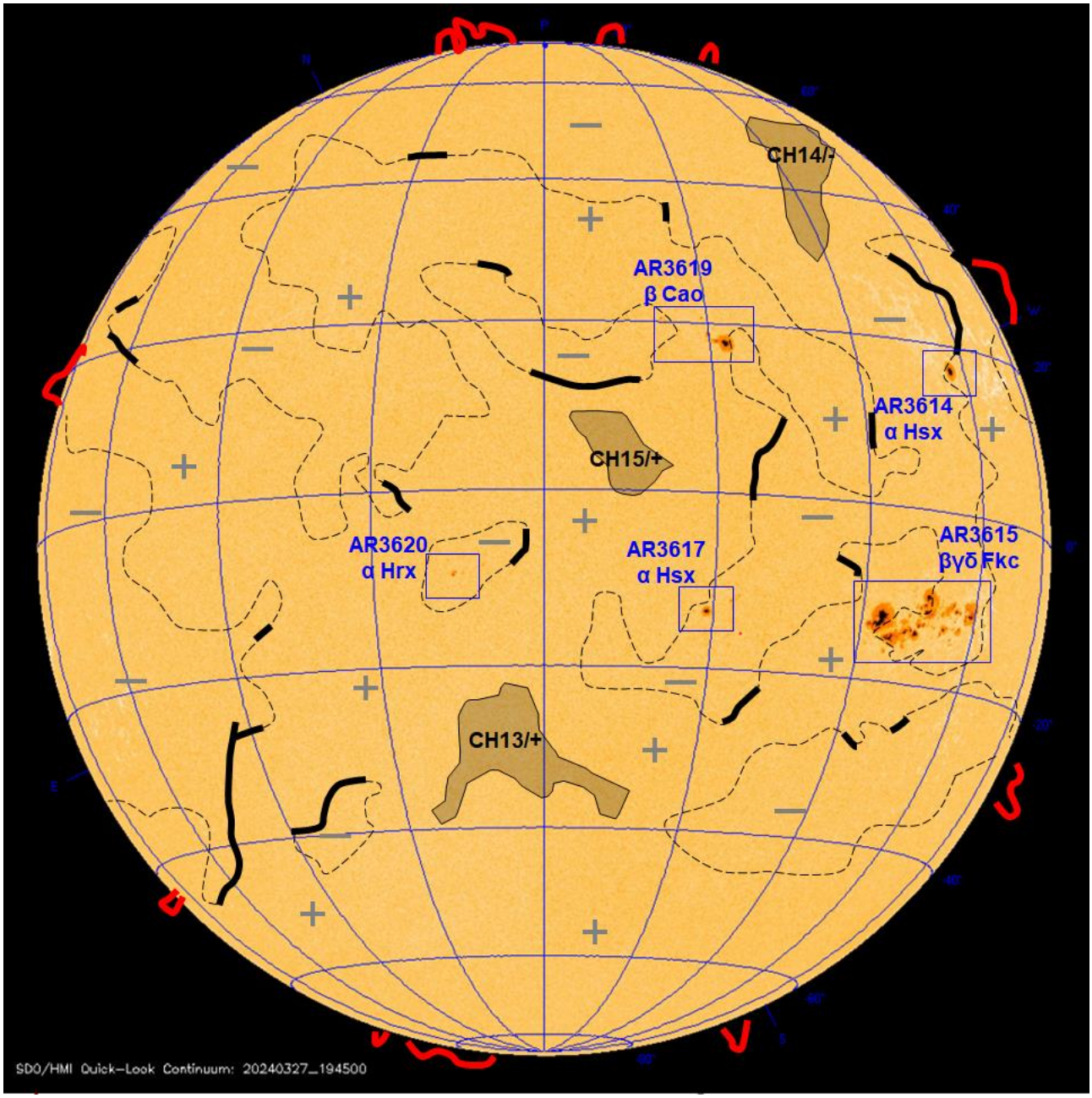
Energetic Particles / Solar Radiation: High energy proton flux, as observed by GOES18 is continuing to decline from recent enhancement. A continued slow decline towards background is expected in the absence of further significant flare activity.
High energy electron flux (greater than 2MeV) near background levels is expected to become enhanced, following the elevated solar winds, with a sharp increase to high levels probable by the end of the period. The associated 24-hour fluence probably breaching Active fluence levels through the guidance period.

Figure 1. Solar Analysis Valid 2000UTC, 27 March 2024.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME associated with the X1.1 flare from a broad region north of AR3614 on 23rd March, produced a notably complex halo CME which impacted L1 at 24/1410UTC. There are no other Earth-directed CME's currently anticipated.

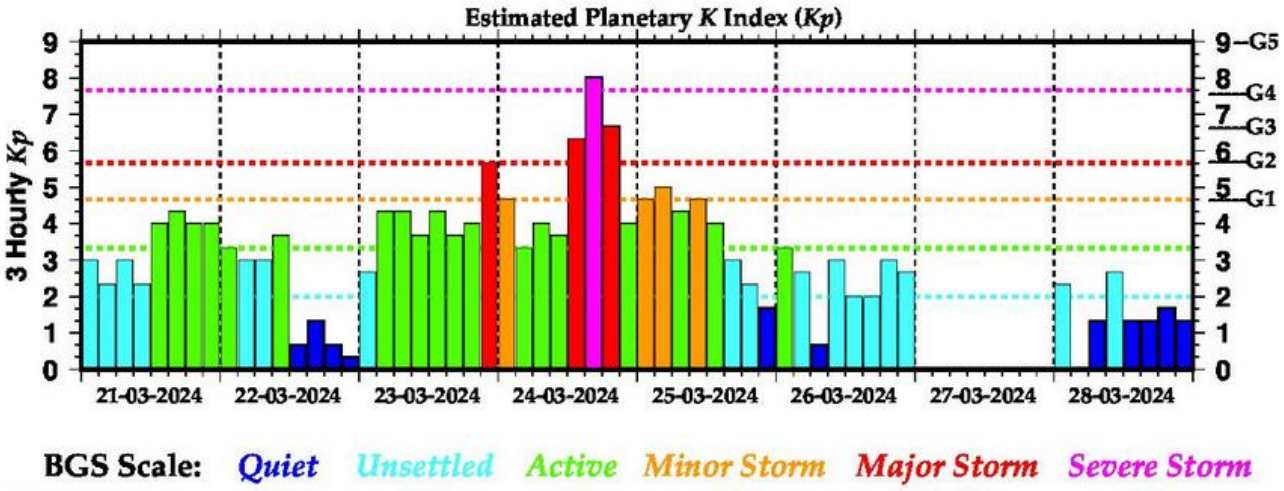
Solar winds now at Slightly Elevated levels, near 500km/s. A continued slow and erratic decline is expected to continue as the impacts from the CME continue to wane, along with any residual enhancement associated with CH12/-. Hence solar winds reducing towards background values into day1 and 2 (28-29 Mar) in the absence of forecast enhancements.
Generally Quiet to Unsettled geomagnetic activity is expected throughout much of the guidance period in the absence of any further CME enhancements.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS plot of planetary K indices for the last 7 days.



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Radio Blackouts - X-Ray Flares:
The current Earth-facing disc continues to be dominated by AR3615 (Fkc/Beta-Gamma-Delta). This region has been the most active region in recent days and produced several M-class flares in recent days but these have become more isolated in the past 24 hours. The X1.1 flare on the 23rd was primarily associated with AR3614, which remains generally stable and much more magnetically simple, though it remains within a large plage region. All other regions remain comparatively magnetically simple and much smaller with most uni-polar in structure.

AR3615 will remain on the visible disc for the majority of this guidance period, and will continue to represent a high risk of activity, with further M-class flares expected and a slight chance of an isolated X-class flare. Some data from far-side sounding suggests that returning regions may rotate onto the southeast disk during the latter half of this guidance period.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	70	60	50	40
Very Active	R3 to R5 X Class	No	20	15	10	10

Figure 3: GOES16-18 X-Ray flux trace for the past 24 hours.

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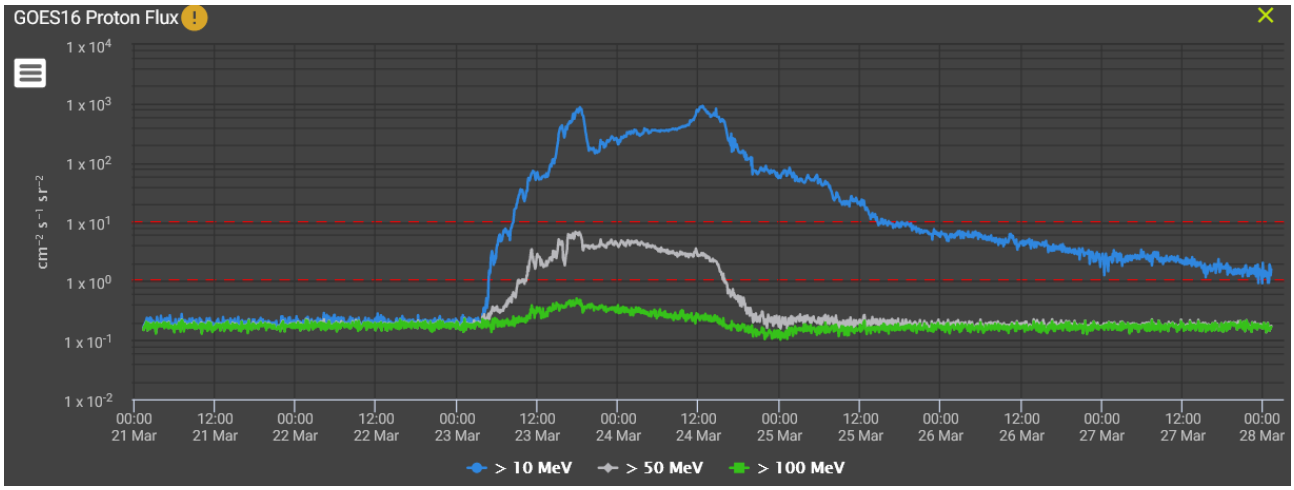
Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES18 is continuing to decline from recent enhancement. A continued slow decline is expected in the absence of further significant flare activity, with the chance of any further enhancement dominated by AR3615 as it makes continued progress westward.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4:



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High Energy Electrons Event (≥ 2MeV):
GOES16 high energy electron flux is at background levels given the likely ongoing connection to the HSS of CH12/- and recent strong CME passage. As geomagnetic activity continues muted and solar winds likely ease over the next few days the electron flux at GEO is expected to quickly rise to Moderate or High levels.
The associated 24-hour fluence is currently below the Active threshold. Fluence and will rise sharply in the coming days with active fluence becoming increasingly likely. MOSWOC REFM output now shows better guidance than recently and may now actually be underplaying the anticipated increase in Fluence in coming days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	60	80	80	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	5	20	20	20

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